



IS MONKEY POX A DAWNING ZONOTIC VIRAL INFECTION IN HUMANS AFTER THE SMALLPOX POST-EXTERMINATION ERA?

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ABSTRACT

As the Universe is an illusory convalescence from Covid-19 and it's not over yet, additional viruses have struck on our doors. Monkey pox (MPX) is a viral zoonotic disease. In 1958, MPX was first discovered in colonies of monkeys, hence the name 'monkey pox.' In 1970, the first human case of monkey pox was reported from Democratic republic of Congo. Monkey pox virus infection has been detected in squirrels, Gambian pouched rats, dormice, and some species of monkeys. Cases of monkey pox virus, which started in the United Kingdom, have now been confirmed in more than 12 countries. So far, 300 suspected or confirmed cases of monkey pox have been detected in non-endemic countries. According to the US Centers for Disease Control and Prevention (CDC), monkey pox begins with a fever, headache, muscle aches, back ache, and exhaustion. It also causes the lymph nodes to swell (lymphadenopathy), which smallpox does not.

KEYWORDS: Monkey pox virus, transmission, animal diseases, Orthopoxvirus, zoonotic disease.

INTRODUCTION:

Within the space of three weeks in May 2022, a cluster of cases of monkey pox were found in the United Kingdom, and shortly thereafter in Spain and Portugal, which were quickly recognised as belonging to a major—and still ongoing—outbreak of monkey pox (1,2). The first recognized case was confirmed on 6 May 2022; an individual with travel links to Nigeria, but it has been suggested that cases were already spreading in Europe in the previous months (3, 4). Monkey pox is an infectious viral disease that can occur in both humans and some other animals (5). Early symptoms include fever, headache, and muscle pains, shivering, backache, and feeling extremely tired (6). Typically there are swollen lymph nodes behind the ear, below the jaw, in the neck or in the groin. (7) The virus normally circulates among certain rodents (8). Diagnosis can be confirmed by testing a lesion for the virus's DNA (9). The disease can appear similar to chickenpox (10). The smallpox vaccine can prevent infection with 85% effectiveness (11). Complications include secondary infections, pneumonia, sepsis, encephalitis, and loss of vision if severe eye infection (12). Eradicating smallpox and lack of vaccination efforts paved the way for monkey pox to gain clinical relevance (13). Most cases of monkey pox occur in rural Africa. (14). Lesions start in the oropharynx then appear on the skin (15). Although human-to-human transmission has previously been limited, mathematical modeling in the context of decreasing herd immunity to orthopoxviruses reflects an increasing threat of disease spread between humans (16). Serum antibodies are often detectable by the time lesions appear (17). Considering the similarities between human monkey pox infection and smallpox, the "Acute, Generalized Vesicular or Pustular Rash Illness Protocol" created by the CDC with the addition of lymphadenopathy to requisite primary criteria could be used to determine which patients warrant further testing (18). The CDC recommends that healthcare providers don a full set of personal protective equipment (PPE) before caring for an infected person. An infected person should be isolated in preferably a negative air pressure room or at least a private exam room to keep others from possible contact (19). BMJ Best Practice recommends tecovirimat or the smallpox treatment brincidofovir as the first line antiviral treatment if required, alongside supportive care (including antipyretic, fluid balance and oxygenation). Empirical antibiotic therapy or aciclovir may be used if secondary bacterial or varicella zoster infection is suspected, respectively (20).

History:

Monkey pox was first identified in laboratory cynomolgus monkeys in Denmark, by Preben von Magnus in 1958 (21). An outbreak of monkey pox at Rotterdam Zoo was reported in 1964. Subsequently monkey pox was detected in several laboratory monkeys in the US (22). No further cases in laboratory monkeys occurred after 1968 as conditions for monkeys improved and the requirement for monkeys, used mainly for producing the polio vaccine, from Asia and Africa fell. The virus was never found in Asia, and the occurrence in Asian monkeys was likely due to contracting the disease in captivity and transit, or contamination (23). The first documented case in humans was in 1970, in an unvaccinated 9-month old boy in the Équateur Province Democratic Republic of the Congo (formerly Zaire) (24). Almost 50 cases were reported between 1970 and 1979, with more than two thirds of these being from Zaire. The other cases originated from Liberia, Nigeria, Ivory Coast and Sierra Leone (25). By 1986, over 400 cases in humans were reported. Small viral outbreaks with a death rate in the range of 10% and a secondary human-to-human infection rate of about the same amount occur routinely in equatorial Central and West Africa (26).

Out breaks:

First case of monkey pox was confirmed in a Nigerian person on May 7 in the U.K. The virus has spread to at least 21 countries and infected 226 people, predominantly, in North America and Europe. May 26. In the UK, 106 laboratories reported confirmed MPX cases. In Canada, a patient had symptoms of monkey pox on April 29, but was not tested at that time. All the 21 countries that have reported at least one case are non-endemic for monkey pox. In Spain and Belgium countries, two rave parties have spread high incidence of infection rates. Between September 2014 and February 2016, 587 suspected MPX cases were reported through a passive surveillance program of the DRC. 320 suspected cases were younger than 15 years, 256 were 15 or older. 592 clinical specimens were obtained from 339 patients which represents 57.8% of all reported suspected cases. 223 tested positive for MPXV, 40 for VZV and 78 for neither. There were two cases of coinfection with both, MPX and VZV (27). Between January and August 2017, ROC, Likouala province reported monkey pox outbreak accounting for 88 cases out of which 7 were laboratory confirmed, including 6 deaths (CFR 6.8%). A total of 18 villages in 5 districts (Enyelle, Betou, Dongou, Impfondo, and Owando) have been affected (28).

The outbreak was formally declared by the Congo state authority on 13th March. Children less than 15 years of age were the most affected, accounting for 60% of the overall caseload. The gender distribution was proportionate, with 51% of the cases being female (29). Two outbreaks were reported in CAR in 2017. The first outbreak was reported in Mbomou province in February 2017. Limited information is available for this event. 47 cases (5 confirmed) were reported by WHO in the bulletin of week 22 (30). The second outbreak was reported in Mbaki district in April 2017 accounting for 3 cases, out of which 1 was laboratory confirmed. No deaths were reported. Further investigations supported by the Ministry of Health and WHO revealed that 24 of 26 (92.3%) of close contacts had antibodies (IgG) against monkeypox, and 4 against cowpox. This suggests a high level of circulation of the virus in the region, and may explain the low number of cases recorded during these outbreaks (31). One isolated case of monkeypox was confirmed in Sierra Leone (Pujehon District) in March 2017. Thirteen close contacts were followed up and none of them have developed any febrile illness and/or skin lesions in the first 21 days since the last exposure (32).

From September 2017 through April 2018, 244 cases including 101 confirmed cases were geographically spread across 25 states and the Federal Capital Territory (FCT) of Nigeria. The confirmed cases were reported from 15 (out of 36) states (33). Six deaths were recorded (CFR 2.5). From September to December 2017, the majority of cases were male (75%) and aged 21–40 years old (median 30 years). (34). The investigation established that the initial cluster of cases (two brothers, their uncle, and a neighbor) fell sick after killing and eating a captured monkey from the neighborhood, which young boys regularly played with (35). Sixteen cases of monkeypox, including 2 confirmed cases, were reported in Liberia between November and December 2017. (36). between week 1 and 24 of 2018, there have been 2845 suspected cases of monkeypox in 14 provinces of the DRC, including 36 deaths (CFR 1.3%). Of the suspected cases, 34 have been confirmed samples. Sankuru Province has had an exceptionally high number of cases between week 1 and 14 of this year (106 cases) compared to the same time period last year (44 cases) (37). However, in September 2019, the FDA approved a vaccine, and two antivirals authorized for managing smallpox have shown assurance in animal studies. It is unclear how long it would take to contain the outbreak. There is a prospective menace of the virus reaching from humans to animals, which may make it endemic in these countries.

Structure:

Monkeypox is a rare disease that is caused by infection with monkeypox virus. Monkeypox virus belongs to the Orthopoxvirus genus in the family Poxviridae. The Orthopoxvirus genus also includes variola virus (which causes smallpox), vaccinia virus (used in the smallpox vaccine), and cowpox virus. MPXV is a 200 to 250 nm brick-shaped enveloped virus with characteristic surface tubules and a dumbbell-shaped core component. The MPXV genome consists of linear double-stranded DNA. Monkeypox virus is antigenically related to the variola and vaccinia viruses, that causes monkeypox in humans and other animals.

Natural host of Monkey pox virus:

Various animal species have been identified as susceptible to monkeypox virus. This includes rope squirrels, tree squirrels, Gambian pouched rats, dormice, nonhuman primates and other species.

Transmission:

Close communication with bodily fluids, skin diseases, or respiratory secretions of infected animals can cause transmission, as can indirect contact with contaminated fomites. Whereas human-to-human transmission has been limited in the past, mathematical modelling in the setting of declining herd immunity against orthopoxviruses indicates that disease spread between people is becoming a greater hazard. In the hospital setting, the Center for Disease Control and Prevention (CDC) advises isolation with standard, contact, and droplet precautions, with advancement to airborne precautions if possible.

Monkey pox virus is found in semen. Is it enough to call it STI ?

Monkeypox is spreading through sexual contact as indicated by the initial presentation of genital or perianal rashes in many cases, said WHO, and now a new study has found the presence of virus in seminal fluid. Reports also showed that the outbreak in several non-endemic countries was predominant in particular social network-men who have sex with men (MSM)-a fillip to the sexual transmission theory.

Replication:

The monkeypox replication occurs at the inoculation site after entering via any channel (oropharynx, nasopharynx, or intradermal). It subsequently travels to local lymph nodes. Following then, viral propagation and planting of other organs occurs as a result of an initial viremia. This is the incubation period, which can last anywhere from 7 to 14 days with a maximum of 21 days.

Symptoms:

Symptom onset is linked to secondary viremia, which causes prodromal symptoms including fever and lymphadenopathy for 1 to 2 days before lesions emerge. At this time, infected individuals may be contagious. Lesions begin in the oropharynx and progress to the skin. By the time lesions emerge, serum antibodies are frequently detected. Previous travel to endemic places, interaction with wild animals transported from endemic areas, and care for an infected ani-

mal or human are all historical markers for monkeypox infection, but clinical symptoms are the most important. The earliest signs of monkeypox are headache, fever, fatigue, myalgia, and lymphadenopathy, which separate it from smallpox. Mucosal lesions in the mouth emerge 2 to 3 days later, followed by centrifugally focused skin lesions on the face and extremities. Dermatitis can extend to other parts of the body, with a number of lesions ranging from a few to thousands. The lesions progress through macules, papules, vesicles, and pustular stages during the next 3 to 4 weeks with increments. Lesions are hard, deep, and 1 to 9 mm in size, and they alter synchronously. Before crusts form, lesions are in the pustular stage for 5 to 7 days. Crusts develop and desquamate over the next 7 to 14 days, and in most cases, the condition cures three to four weeks following symptom beginning. After all crusts have fallen off, the patient is no longer considered contagious. Given the similarities between human monkeypox and smallpox, the CDC's diagnostic protocols might be utilised, with lymphadenopathy added to the required primary criteria.

Has Monkey pox reached India?

5-Year old girl samples were sent to the ICMR NIV, Pune for testing of Monkey pox. The suspected case created panic among people as speculations of monkey pox reaching India were a buzz.

C-Section Advised for Pregnant Women Diagnosed with Monkey pox:

A report published in Ultrasound in Obstetrics and Gynecology advised that pregnant women should opt for C-sections to avoid infecting their baby during delivery. Dr. Edward Morris, Royal College of Obstetricians and Gynecologists stated that infants and children are at a greater risk of serious illness if they are exposed to monkey pox infection. Globally, the risk of monkeypox infection has remained low in the general public, though cases have continued to rise, especially in the UK. (40)

WHO: More than 1000 Monkeypox Cases have been reported

WHO Director-General Tedros Adhanom Ghebreyesus stated that the risk of monkeypox has been established in non-endemic countries. However, they are preventable at this point if proper precautionary measures are taken. More than 1000 monkeypox cases have been reported to WHO, in the current outbreak outside the countries in Africa, where it is an endemic disease

MONKEYPOX:

Poxviruses cause infection in the formation of lesions, skin nodules or disseminated rash.

Monkey pox clinical features:

1st Invasion period: (0-5 days)

Fever, headache, myalgia, fatigue, and lymphadenopathy (preauricular, axilla, inguinal, cervical)

2nd phase:

After 1 to 2 days of fever

- Skin lesions develop on the face and extremities (including palms and soles) and are centrifugally concentrated
- Oral, conjunctival or genital mucosa can also be involved.

Over the following 2 to 4 weeks,

- The lesions evolve through macular, papular, vesicular, and pustular phases.
- Lesions change synchronously and are characterized as 2 to 10 mm in size, firm, deep-seated umbilicated pustules
- After 5 to 7 days they form crusts, desquamate over the subsequent 7 to 14 days and are noninfectious after the crusts fall off.
- The condition resolves around 3 to 4 weeks after symptom onset in most cases.

Diagnosis:

Testing for the presence of MPXV should be performed in appropriately equipped laboratories by staff trained in the relevant technical and safety procedures. Confirmation of MPXV infection is based on nucleic acid amplification testing (NAAT), using real-time or conventional polymerase chain reaction (PCR), for detection of unique sequences of viral DNA. PCR can be used alone, or in combination with sequencing. Several groups have developed validated PCR protocols for the detection of OPXV and more specifically MPXV. (38, 39, 40). Some protocols involve two steps, in which the first PCR reaction detects OPXV, but does not identify which species. This can then be followed by a second step, which can be PCR-based or utilize sequencing, to specifically detect MPXV. Before an assay is utilized to test human clinical specimens within a laboratory, it should be validated and/or verified within the laboratory by appropriately trained staff.

Treatment:

- Patient isolation:

Wear a surgical mask keep lesions covered as much as reasonably possible until all lesion crusts have naturally fallen off

- Supportive care
Most patients recover without medical intervention

Hospital stays for intravenous hydration

- Antiviral therapy

Indications:

- Severe disease
- Immunocompromised patients
- Children younger than eight years of age
- Pregnant or breastfeeding women
- Patients with complications of the infection
- Atypical sites (eg, mouth, eyes, genital area)

Specific agents:

- Tecovirimat: Treatment of choice Oral and intravenous preparations are available. The recommended dose of tecovirimat depends upon the patient's weight; The duration of treatment is 14 days.
- Cidfovir/Brincidofovir in vitro activity against monkeypox in animal models. no clinical data regarding its efficacy in humans. In some circumstances, post-exposure immunisation with modified vaccinia, Ankara vaccine (live, non-replicating smallpox and monkeypox vaccine) is advised. Exposure between damaged skin or mucous membranes with an infected patient's respiratory droplets, bodily fluids or scabs is deemed a "high risk" exposure that demands urgent post-exposure immunisation. According to the CDC, vaccination within three days of exposure may prevent disease onset, whereas vaccination within two weeks may reduce disease severity. More data gathering and feasibility research are needed to determine the possible merits and disadvantages of prophylactic monkeypox immunisation in endemic areas. The capacity to make informed judgments on how to best manage this neglected tropical illness is hampered by a lack of medical care, diagnostic skills, and infrastructure. Although there are no precise therapies for monkeypox infection at present time, breakouts can be controlled. A monkey pox outbreak can be controlled with smallpox vaccine, cidofovir, ST-246, and vaccinia immune globulin (VIG). The latest public evidence about the benefits and dangers of smallpox vaccination and medicine use for the care and mitigation of monkeypox as well as other orthopoxvirus infections was used to establish WHO guidance.



WHO: Monkeypox won't turn into pandemic, but many unknowns

The World Health Organization's top monkeypox expert said she doesn't expect the hundreds of cases reported to date to turn into another pandemic, but acknowledged there are still many unknowns about the disease, including how exactly it's spreading and whether the suspension of mass smallpox immunisation decades ago may somehow be speeding its transmission. In a public session on, the WHO's Dr. Rosamund Lewis said it was critical to emphasise that the vast majority of cases being seen in dozens of countries globally are in gay, bisexual or men who have sex with men, so that scientists can further study the issue and for populations at risk to take precaution.

Monkey pox vaccination begins to try to halt the spread of the virus.

Countries including Canada, the USA, have begun implementing a strategy called "Ring vaccination" this involves administering smallpox vaccines, which are thought to be effective against monkeypox because the viruses are related to people who are known to have been exposed through close contact with an

infected person. But there are unknowns and challenges that come with using this strategy for monkeypox, says Natalie Dean, a biostatistician at Emory University, in Atlanta, Georgia. Although the vaccines are considered to be safe and effective for use in people with smallpox infection, the vaccines have had limited testing against monkeypox.

Monkey pox: A new unfolding global health emergency?

As the world is seemingly recovering from Covid-19 and it's not over yet, another virus has knocked on our doors. Some parts of the world are experiencing an outbreak of monkeypox, a viral infection similar to smallpox though less severe and less infectious. So far, at least 11 countries, outside of the endemic areas, have reported cases of monkeypox.

Monkey-pox latest News flash WHO says that inter personal physical contact is the primary route for viral transmission. "Aerosol risk for monkeypox is not yet fully understood"

Management:

One has to avoid close contact with animals that may have been infected with the virus (which categorizes living organisms that have been sick or that have died in regions where monkeypox is prevalent). Avoid touching any objects that have made contact with clinically infected animals. One has to separate infectious patients from those who are clinically healthy. This infection currently has no specific clinically proven treatments as is the case with many viral diseases. The therapy involves purely symptomatic management, as is the case with most viral infections. However, there are precautions that can be taken to help avoid an outbreak. Until enough lesion edges have spontaneously come off and a new skin layer has grown, the infected patient should be kept in isolation, the lesions should be covered and masked with a cloth and everyone involved should wear a surgical mask. Individuals who have been exposed to the virus should have their temperature and symptoms checked twice a day for three weeks, as this is the recognised limit set of the monkeypox incubation time. Because infectiousness coincides with the start of symptoms, close contacts do not need to be isolated while asymptomatic.

CONCLUSION:

MPXV is named due to its initial detection in monkeys. MPXV can primarily be found in rodents. Swollen lymph nodes are typical of monkeypox. However, lesions may be haemorrhagic or coalesce into large bullae. Positive detection using an OXPV PCR assay followed by confirmation of MPXV via PCR and/or sequencing, or positive detection using MPXV PCR assay in suspected cases in endemic and nonendemic areas indicates confirmation of MPXV infection. According to the CDC, vaccination within three days of exposure may prevent disease onset, whereas vaccination within two weeks may reduce disease severity.

REFERENCES:

- "So, Have You Heard About Monkeypox?". The Atlantic. 19 May 2022
- "Multi-country monkeypox outbreak in non-endemic countries". World Health Organization. 21 May 2022. Retrieved 25 May 2022
- "Monkeypox – United Kingdom of Great Britain and Northern Ireland". World Health Organization. 16 May 2022. Archived from the original on 17 May 2022. Retrieved 17 May 2022.
- Nsofor, Ifeanyi (2 June 2022). "OPINION: Media coverage of monkeypox paints it as an African virus. That makes me mad". NPR. Retrieved 2 June 2022.
- "Monkeypox". www.who.int. World Health Organization. 19 May 2022. Retrieved 28 May 2022.
- Petersen, Brett W.; Damon, Inger K. (2020). "348. Smallpox, monkeypox and other poxvirus infections". In Goldman, Lee; Schafer, Andrew I. (eds.). Goldman-Cecil Medicine. Vol. 2 (26th ed.). Philadelphia: Elsevier. pp. 2180–2183. ISBN 978-0-323-53266-2.
- "Monkeypox: signs and symptoms". CDC. 16 July 2021. Archived from the original on 23 May 2022. Retrieved 23 May 2022.
- "Transmission Monkeypox". CDC. 11 May 2015. Archived from the original on 15 October 2017. Retrieved 15 October 2017.
- "2003 U.S. Outbreak Monkeypox". CDC. 11 May 2015. Archived from the original on 15 October 2017. Retrieved 15 October 2017.
- McCollum AM, Damon IK (January 2014). "Human monkeypox". Clinical Infectious Diseases. 58 (2): 260–267
- "Treatment | Monkeypox | Poxvirus | CDC". www.cdc.gov. 2021-07-18. Archived from the original on 2019-06-15. Retrieved 2022-05-18.
- "Monkeypox". www.who.int. World Health Organization. Retrieved 22 May 2022.
- Nguyen PY, Ajisegiri WS, Costantino V, Chughtai AA, MacIntyre CR. Reemergence of Human Monkeypox and Declining Population Immunity in the Context of Urbanization, Nigeria, 2017-2020. Emerg Infect Dis. 2021 Apr;27(4) [PMC free article]
- Sklenovská N, Van Ranst M. Emergence of Monkeypox as the Most Important Orthopoxvirus Infection in Humans. Front Public Health. 2018;6:241.
- Hutson CL, Carroll DS, Gallardo-Romero N, Drew C, Zaki SR, Nagy T, Hughes C, Olson VA, Sanders J, Patel N, Smith SK, Keckler MS, Karem K, Damon IK. Comparison of Monkeypox Virus Clade Kinetics and Pathology within the Prais-

- rie Dog Animal Model Using a Serial Sacrifice Study Design. *Biomed Res Int*. 2015;2015:965710
- XVI. Grant R, Nguyen LL, Breban R. Modelling human-to-human transmission of monkeypox. *Bull World Health Organ*. 2020 Sep 01;98(9):638-640.
- XVII. Hutson CL, Carroll DS, Gallardo-Romero N, Drew C, Zaki SR, Nagy T, Hughes C, Olson VA, Sanders J, Patel N, Smith SK, Keckler MS, Kareem K, Damon IK. Comparison of Monkeypox Virus Clade Kinetics and Pathology within the Prairie Dog Animal Model Using a Serial Sacrifice Study Design. *Biomed Res Int*. 2015;2015:965710.
- XVIII. McCollum AM, Damon IK. Human monkeypox. *Clin Infect Dis*. 2014 Jan;58(2):260-7
- XIX. "Infection Control: Hospital | Monkeypox | Poxvirus | CDC". www.cdc.gov. 2019-01-03. Retrieved 2022-05-21
- XX. "Poxvirus infection (monkeypox and smallpox) - Treatment algorithm | BMJ Best Practice". bestpractice.bmj.com. Retrieved 2022-05-20.
- XXI. Fenner, Frank; Wittek, Riccardo; Dumbell, Keith R. (1988). "1. Historical introduction and overview". *The Orthopoxviruses*. Elsevier. pp. 11–12. ISBN 978-0-323-15022-4
- XXII. Cho, C. T.; Wenner, H. A. (March 1973). "Monkeypox virus". *Bacteriological Reviews*. 37 (1): 1–18. doi:10.1128/br.37.1.1-18.1973. ISSN 0005-3678.
- XXIII. Fenner, Frank; Wittek, Riccardo; Dumbell, Keith R. (1988). "8. Monkeypox virus". *The Orthopoxviruses*. Elsevier. pp. 227–267. Retrieved 2022-05-26
- XXIV. Bunge, Eveline M.; Hoet, Bernard; Chen, Liddy; Lienert, Florian; Weidenthaler, Heinz; Baer, Lorraine R.; Steffen, Robert (11 February 2022). "The changing epidemiology of human monkeypox—A potential threat? A systematic review". *PLOS Neglected Tropical Diseases*. 16 (2): e0010141
- XXV. Breman JG, Steniouski MV, Zanotto E, Gromyko AI, Arita I (1980). "Human monkeypox, 1970–79". *Bulletin of the World Health Organization*. 58 (2): 165–182.
- XXVI. Meyer H, Perrichot M, Stemmler M, Emmerich P, Schmitz H, Varaine F, et al. (August 2002). "Outbreaks of disease suspected of being due to human monkeypox virus infection in the Democratic Republic of Congo in 2001". *Journal of Clinical Microbiology*. 40 (8): 2919–2921
- XXVII. Sklenovská N. Epidemiology and laboratory diagnosis of Monkeypox virus in Africa. Master's Thesis. Leuven: KU Leuven (2017).
- XXVIII. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, week 48 2017. (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/259557/1/OEW48-2504122017.pdf>. (accessed 22/03/2018)
- XXIX. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, week 18 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/handle/10665/255272/OEW18-294552017.pdf?sequence=1> (Accessed 22/03/2018).
- XXX. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, Week 22 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/255624/1/OEW22-270262017.pdf> (Accessed 22/03/2018)
- XXXI. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, Week 28 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/255895/1/OEW28-81472017.pdf> (Accessed 22/03/2018)
- XXXII. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, week 16 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/255050/1/OEW16-152142017.pdf> (Accessed 22/03/2018)
- XXXIII. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, Week 26 2018 (2018). Available online at: <http://apps.who.int/iris/bitstream/handle/10665/272981/OEW26-2329062018.pdf> (Accessed 09/07/2018).
- XXXIV. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, Week 42 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/259352/1/OEW42-1420102017.pdf> (Accessed 22/03/2018)
- XXXV. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, Week 42 2017 (2017). Available online at: <http://apps.who.int/iris/bitstream/10665/259352/1/OEW42-1420102017.pdf> (Accessed 22/03/2018)
- XXXVI. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, week 8 2018 (2018). Available online at: <http://apps.who.int/iris/bitstream/10665/260335/1/OEW8-1723022018.pdf> (Accessed 22/03/2018)
- XXXVII. WHO. Weekly Bulletin on Outbreaks and Other Emergencies, week 14 2018 (2018). Available online at: <http://apps.who.int/iris/bitstream/handle/10665/272343/OEW14-310306042018.pdf> (Accessed 09/07/2018)
- XXXVIII. Li Y, Zhao H, Wilkins K, Hughes C, Damon IK. Real-time PCR assays for the specific detection of monkeypox virus West African and Congo Basin strain DNA. *Journal of Virological Methods*. 2010 Oct;169(1):223–7.
- XXXIX. Schroeder K, Nitsche A. Multicolour, multiplex real-time PCR assay for the detection of human-pathogenic poxviruses. *Molecular and Cellular Probes*. 2010 Apr;24(2):110–3.
- XL. #Hospital Medicine #Infectious Diseases #Obstetrics and Gynecology #Pathology and Lab Medicine #Public Health
- XLI. Maksyutov RA, Gavrilova EV, Shchelkunov SN. Species-specific differentiation of variola, monkeypox, and varicella-zoster viruses by multiplex real-time PCR assay. *Journal of Virological Methods*. 2016 Oct;236:215–20.
- XLII. Moore M, Zahra F. Monkeypox. [Updated 2022 May 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from:
- XLIII. Guidelines on diagnosis and management of monkeypox-medical dialogue june 1 2022